

Antimicrobial Use by Backyard Food Animal Producers in Ecuador: A Qualitative Study

William F. Waters (✉ wwaters@usfq.edu.ec)

Universidad San Francisco de Quito

Martin Baca

Universidad San Francisco de Quito

Jay P. Graham

University of California, Berkeley

Zachary Butzin-Dozier

University of California, Berkeley

Lenin Vinueza

Universidad San Francisco de Quito

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Abstract

Background: Antimicrobials are widely used throughout the world in food animal production for controlling and preventing disease and for promoting growth. But this trend also has the potential for promoting antimicrobial resistance, which represents a threat to human, animal, and environmental health. The use of antimicrobials and the potential effects of antimicrobial dependence has often been associated with large-scale food animal production. But rural households also engage in small-scale agricultural production, often operating literally in backyards. While some small-scale producers use veterinary antimicrobials, most do not. This paper examines knowledge and attitudes to understand alternative practices.

Methods: Qualitative field research was based on four focus group discussions (FGDs) with backyard food animal producers in six communities near Quito, Ecuador and two FGDs with veterinarians. FGDs were supplemented by structured observations and key informant interviews. They were recorded with digital audio devices and transcriptions were analyzed independently by two researchers using a three-stage coding procedure. Open coding identifies underlying concepts, while axial coding develops categories and properties, and selective coding integrates the information in order to identify the key dimensions of the collective qualitative data.

Results: The qualitative data analysis shows that first, backyard food animal producers use few purchased inputs, including antimicrobials for keeping small numbers of animals and poultry for predominantly non-commercial household consumption and they use traditional veterinary remedies at little or no cost. Second, indigenous households and other small-scale producers in the Ecuadorian highlands and other parts of the Andean region retain traditional views of human productive activity as a component of the physical and spiritual environment.

Conclusions: Backyard food animal producers in the Ecuadorian highlands implement complex household survival strategies based on both economic calculations and sociocultural underpinnings that shape perceptions, attitudes, and practices. They use traditional veterinary remedies in lieu of antimicrobials in most cases because limited production of food animals in small spaces allows them to contribute to a predictable household food supply, while at the same time conforming to traditional concepts of human and environmental health.

Background

The use of antimicrobials in animal food production for controlling and preventing disease and for promoting growth is common throughout the world. An estimated 63,151 tons of antimicrobials were used in food animal production worldwide in 2010, and use is expected to increase by 67 percent to 105,596 tons by 2030 [1]. This trend has been termed “ominous” [2] because of potential for promoting antimicrobial resistance, which represents a threat to human, animal, and environmental health worldwide. Antimicrobial resistance is associated 700,000 annual deaths globally and with a projected

loss of 10 million lives by 2050 [3]. While the use of antimicrobials may enhance productivity, it also creates the potential for spreading multidrug-resistant bacteria throughout the food chain [4] and in settings where domestic animals live in close contact with workers, members of nearby households (including children), and inhabitants of surrounding communities [5–7]. The interwoven trends toward the intensification and concentration of food production; the globalization of marketing, transportation, and commerce; and evolving patterns of worldwide consumer demand have tended to accentuate the use of antimicrobials.

The use of antimicrobials in commercially oriented large-scale food animal production that often resembles factory-style manufacturing has received substantial attention with respect to the effects of antimicrobial dependence [8, 9]. But at least 450 million rural households engage in small-scale agricultural production worldwide, constituting 85 percent of farms worldwide [10], and the farming systems of low-resource, small-scale agricultural producers often include poultry and other food animal species as a critical component of household food security [11], which often incorporates complex mixes of productive and income-generating activities as well. These farming households are often limited to extremely small spaces where crop production and food animal production are carried out—literally in back yards—using the least amount of financial and material resources necessary. This component of household survival strategies functions largely beyond commercial circuits and is not designed to generate profit. Little or nothing is invested in infrastructure, equipment, or materials, and losses are accepted as part of the process of using limited resources to make ends meet in challenging environments [12].

The use of antimicrobials by small-scale food animal producers has been noted in low- and middle-income countries [13, 14] and is often influenced by information and misinformation provided by veterinary product vendors [15, 16]. In contrast, though, many small-scale producers depend on traditional sources of information to inform their decision-making, and they use traditional veterinary remedies made from local plants and other readily available ingredients [17, 18]. While overall global trends suggest that food animal production is in general likely to be increasing intensive and based on maximizing productivity through the use of antimicrobials, alternative patterns are also observable and explain why small-scale food animal production persists and in many developing countries, despite limited access to land and other productive resources.

Thus, rural households—even those that are in close proximity to spreading urban centers—have retained their agrarian roots and have continued to practice small-scale production of crops and food animals in combination with income-generating activities based on wage labor, petty commerce, and transportation [19]. While these households may occasionally engage in sale, gifting, or exchange, they keep animals—literally in their back yards—as an essential contribution to the household’s food security. The purchase of equipment and materials in these cases is minimal or entirely absent; poultry are kept at night in makeshift coops constructed of leftover or recycled building materials such as plywood and corrugated metal roofing; during the day, chickens and ducks forage in the backyard for insects, seeds, household scraps, and the like. Small numbers of larger species (usually just one or two per family) such as sheep,

goats, and pigs, are either staked out on roadsides or are kept in nearby lots to graze. Cattle are rarely kept by backyard producers because they require access to larger amounts of land. Expensive animal feed is rarely purchased and as discussed in this paper, veterinary medications including antibiotics are not usually purchased or used. In sum, backyard production is part of a household subsistence strategy that also includes cash income earned by some family members as well as limited production of vegetables, tubers, and grains in what amounts to large gardens.

Throughout the Andean region of South America, small-scale, basically subsistence-oriented agriculture and food animal production represent an important part of the rural landscape, while adapting to emerging conditions and opportunities [20]. In the Ecuadorian highlands, small-scale, limited resource food animal production persists even though large-scale agribusiness has penetrated into the region [21] and some small-scale producers engage in intensive, commercially oriented production [22, 23] – and also in the face of transnational migration from rural areas [24]. In Ecuador, rural households engage in small-scale food animal production using limited resources and inputs and may base their decisions and practices on traditional concepts of environmental and human health [25].

This paper reports on backyard food animal production in the peri-urban communities of Quinche, Yaruqui, Checa, Pifo, Puenbo, and Tumbaco, which are located in the Ecuadorian highlands near the capital city of Quito. These towns are formally considered rural parishes and their residents have for decades continued to engage in small-scale backyard food animal production and agriculture, while at the same time maintaining close links to Quito for work, health care, and commerce [26]. Recent studies conducted in these communities have documented the use of antimicrobials in food animal production as well as the potential health and environmental impacts [7, 13]. These studies estimate that around 20 percent of small-scale food animal producers report using antimicrobials [27, 28] with misuse being attributed to lack of information or knowledge [29] and to unscrupulous sales tactics by vendors of veterinary products [27].

The question remains, though: while some backyard food animal producers use antimicrobials, why is it that most do not? The aim of this paper is to suggest that by virtue of an empirical cost-benefit analysis, these producers largely eschew the use of purchased inputs, including antimicrobials, for keeping small numbers of animals and poultry for non-commercial household consumption as an essential component of family food security. Lacking the economic motivation to optimize productivity through the use of antimicrobials, they use traditional veterinary remedies at little or no cost while accepting a fairly predictable amounts of loss.

Beyond the strictly economic, there is a second reason for which backyard producers avoid using antimicrobials for disease prevention and control or for growth prevention. Historically, peasant farmers, indigenous households, and other small-scale producers in the Ecuadorian highlands and other parts of the Andean region have retained a traditional view of human productive activity as a component of the physical and spiritual environment that surrounds them and which views Mother Earth (*Pachamama*, in the Kichwa language) as an all-encompassing state of balanced well-being and which is to be revered

and protected and upon which individual, community, and planetary health depends [30, 31]. In this context, the use of antimicrobials is viewed as harmful to human and animal health.

In a larger sense, this broad swath of backyard food animal producers may represent a counterbalance to the potential dangers represented by the overuse of antimicrobials in Ecuador, the Andean region, and beyond. Their production strategies and alternative worldview may therefore provide useful lessons for developing alternatives to the use and potential dependence upon and deleterious effects on human and environmental health of antimicrobials.

Methodology

Qualitative field research was based on four focus group discussions (FGDs) with backyard food animal producers in six communities near Quito, Ecuador and two FGDs with veterinarians. The FGDs were supplemented by structured observations and key informant interviews with a female backyard food animal producer and a technician in the veterinary division of the Ministry of Agriculture and Livestock. The focus group is a planned and directed conversation designed to elicit perceptions, opinions, and insights from several people who share at one or more characteristics relevant to the study. The guided discussion provides a secure and confidential environment in which participants express their ideas in response to those of other participants. The purpose is not to arrive at consensus but rather to understand the breadth and depth of opinions related to the research topic. Key informant interviews (KII) complement focus group discussions by providing in-depth insights from individuals who are knowledgeable because of their personal or professional relationship to that topic of interest. Participants provided written informed consent prior to each respective individual or group conversation [32].

FGDs and KIIs had a duration of between one hour and one hour and a half. They were recorded with digital audio devices and then transcribed verbatim. The transcriptions were analyzed independently by two researchers using a three-stage coding procedure. Open coding identifies underlying concepts, while axial coding develops categories and properties, and selective coding integrates the information in order to identify the key dimensions of the collective qualitative data [33]. Producers were identified by sex and the community where they reside, while veterinarians are identified by sex and group number. The four FGDs conducted with backyard producers included a total of 41 adult male and female participants ranging from 18 to 65 years of age. 85% of the producers were female and the most common occupation was stay at home parent/spouse (46%) and 61% had attained less than a secondary education, which is about the national average. The two FGDs conducted with a total of 18 veterinarians; 83% of whom were male (83%), and all had undergraduate or graduate university training. These participants reported working in private practice, in government positions, or both.

FGD participants provided written informed consent while the KII participants provided verbal consent. The study was approved by the IRBs of the Universidad San Francisco de Quito and the University of California, Berkeley.

Results

The qualitative coding procedure described above identified four key dimensions relevant to the use of antimicrobials by backyard food animal producers: (i) scale of operation, (ii) use of antimicrobials, (iii) knowledge of antibiotic resistance and its consequences, and (iv) government policies.

Scale of operation

Participants in the producer FGDs explained the characteristics of backyard food animal production and how they differ from commercially oriented small-, medium-, and large-scale production. First, according to FGD participants, and confirmed by KII participants and structured observation, backyard producers most commonly keep one or more of the following: between five and 20 chickens and/or guinea pigs and one or two sheep or pigs. Only a few participants reported that they have cows because most do not have enough land to sustain them. Second, they invest little in infrastructure such as coops or fences, often using recycled or left-over materials such as boards and metal sheeting. Third, as discussed in greater detail below, they rarely use antimicrobials or any other veterinary products—and many reported that they never do.

Producer FGD participants explained their management practices in terms of motivation for engaging in backyard production. First, their principal interest is not profit; backyard production is sold only sporadically if there is a special need for income in addition to what household members earn outside of the home or when the number of animals exceeds available resources—especially space. Rather, food animals are kept for household consumption as an important complement to household cash income, which is generally limited, the minimum wage in Ecuador being about \$400 per month. For the same reason, available resources are often used to feed backyard animals and poultry rather than relying exclusively on purchased animal feed.

Poultry production is almost universal since it requires very little investment or space and because meat and eggs are produced relatively quickly. Producer FGD participants also reported that they occasionally give chickens to family members, friends, or neighbors or may trade them for something of equivalent value. Larger species such as pigs are kept for longer periods and are often consumed during year-end celebrations. Participants in the veterinarian FGDs confirmed that for backyard producers, the major reason for keeping animals is household consumption. They also confirmed, as discussed below, that veterinarian services are rarely requested by backyard food animal producers.

FGD participants explained that in contrast to their backyard production, some small-scale producers have a more commercial orientation. While the cutoff point between backyard- and commercial small-scale operation is blurry, the major difference is that the latter invests more in infrastructure even though operations are not large, and in order to maximize production, they may seek the services of veterinarians and use veterinary products, including antimicrobials. One veterinarian explained the difference in this way:

... it is customary for our people to have their animals in a feeding system of between five and 20 birds, as what we call backyard birds. Small producers are people who have small sheds and a fully developed infrastructure, but who are ultimately engaged in chicken production as a business or as a way of subsisting.

More commercially oriented small-scale operators may consume part of what they produce, but that aspect is incidental to sales, which are the primary or only source of household income.

Participants in the veterinarian FGDs were more familiar with practices of medium- and large-scale food animal producers. Medium scale producers were described as having businesses that are large enough to provide sufficient household income without having to recur to other sources, but with modest investments in infrastructure or salaries. In contrast, large-scale producers maintain a larger number of animals (for example, more than 1,000 chickens), and substantial investment is dedicated to salaries, infrastructure, and veterinary products including antimicrobials, which are used for disease prevention and control as well as growth promotion. One veterinarian explained the difference between these levels of production:

there are certain definitions or parameters that you must use to define the small-, medium- or large-scale producer of animals. A small-scale producer, I do not have the exact data, but a small producer is one who has a livelihood and something to live on. A medium-scale producer is one who has a business established and lives on his milk or meat production. A large-scale producer is one that already produces thousands of animals.

In sum, backyard food animal producers are similar to small-scale subsistence agricultural producers, who are also found throughout the Ecuadorian highlands. In both cases, the essential characteristic of production is household subsistence, which necessarily must be supplemented by some source of cash income.

Antimicrobial use

Few participants reported using antimicrobials to prevent or cure disease or to promote growth, and none on a regular basis. The producer KI reported that she has never purchased or used veterinary products of any kind; the only chemical that she has used is household repellent to rid coops of fleas and other insects. She keeps fewer than a dozen chickens and ducks and a few rabbits almost exclusively for household consumption. She sells or trades a single chicken, duck, or rabbit or a few eggs on an irregular basis, often upon request from neighbors or family members. She works as a maid for the minimum wage, and can neither afford inputs nor think they are necessary. With few exceptions, producer and veterinarian FGDs concurred with this view.

Backyard food animal producers identified two principal factors that contribute to or inhibit the use of antibiotics in backyard production. First, given their limited household cash incomes, the cost of these products is often prohibitive. Second, from the perspective of scale of production and the reasons for

engaging in backyard production, an empirical cost-benefit analysis reveals that buying antimicrobials does not make sense because a single diseased animal can be slaughtered and consumed immediately and because there is no reason to promote accelerated growth. A veterinarian FGD participant explained that:

... one of the great advantages of backyard poultry production is that there is no pressure... to grow at 65 grams per day or have 14 to 15 birds per square meter. So, these are birds that do not have production stress and therefore they are animals that are not very challenged., so in short, the consumption of antibiotics at this level is very limited ...

Second, some producers explained that they abstain from using antibiotics on their animals because they believe them to be harmful for their animal's health and, ultimately, for the health of the humans (including themselves), who consume those animals. Similarly, veterinarian FGD participants explained that backyard producers rarely seek professional advice largely because of the cost and because these producers feel they do not need advice as they prefer to rely on their own experience or advice from friends or neighbors.

Finally, producer FGD participants reported that another common consequence of antibiotic use is that the use of medicine or chemicals are changes the meat's flavor. Moreover, participants believe that when animals have received a lot of medication, their meat cannot be consumed at all. They further explained that consuming a "poisoned animal," that has received too much medication, could lead to illness for themselves and their families.

As an alternative to administering antimicrobials, it is common—and nearly universal—that backyard producers use traditional home remedies for disease prevention and control. Producer FGD participants described using chili pepper, onion, garlic, or lemon juice mixed with water and applied in drops. As one female participant explained, "I put lemon in [the water] with chili and with that, the flu is gone." These practices are shared among family members, friends, and neighbors, and only when traditional remedies do not achieve the expected results did participants report that they might use "modern" medicines, and in these cases, they rely on personal experience and recommendations from friends and family to choose—usually the least expensive option.

Sure, you buy the least expensive option because buying eighty or a hundred [doses] already costs more money, so you only buy twenty (female producer, Checa).

In contrast, veterinary FGD participants reported that commercially oriented medium- and large-scale producers are characterized by the indiscriminate use of antimicrobials. As one explained:

People buy a box of a hundred chickens and ask for vitamins and antibiotics and they are told that they do not need them, but no ... There are even people who buy vaccines and an antibiotic for the chicken flu as soon as it is sold. So, we usually tell [customers] that if their poultry doesn't have the flu, why should

they medicate? And they usually medicate after 28 days or in the fourth week. There are people, ... if you don't sell it, you go to another store and buy.

Knowledge of antibiotic resistance and consequences

Producer FGD participants demonstrated that they possess a certain level of understanding about antimicrobial resistance, which informs their decision to use those products or not. Some participants perceived that excessive use leads to “intoxication” as discussed by one female backyard producer who said that when an animal is “intoxicated. ... you can die with too much medicine,” so that traditional or “natural” alternatives are administered. Additionally, it was thought that antimicrobial resistance leads to the use of stronger “chemical” products. Interestingly, few participants remembered where they had heard about antimicrobial resistance, while some reported that this phenomenon had been discussed with neighbors or veterinarians.

Finally, the backyard producers mentioned that one of the most important consequences of overusing antimicrobials is that when a product is no longer effective, stronger alternatives have to be used, which in turn obviates human consumption.

[An animal] is already resistant to the medication you give him. For example, once you get sick with the flu and you use the same medicine and another time the same and the same ... the same as a person (female producer, Yaruqui).

Veterinarian FGD participants reported that antibiotic resistance is a serious problem in Ecuador and that they have begun to witness cases in which infections in food animals are resistant to commonly used antimicrobials, which results in the use of increasingly stronger alternatives that can be harmful to human health. In this sense, the development of antimicrobial resistance is due mainly to the indiscriminate use of antibiotics in animals for human consumption since they are often used for growth promotion and disease prevention in commercially oriented food animal production. This problem also goes hand in hand with a lack of awareness among agricultural and veterinary shop owners, who are also responsible for the increase in antimicrobial resistance because they are willing to sell antibiotics with little control, often without prescription [27]. Additionally, failure to use best practices may lead to overuse of antimicrobials and subsequent resistance. As one veterinarian FGD participant explained:

Among large-scale producers where [veterinarians] have gone to give advice, it has been seen that [producers] do not use the full dosage. And when we do the calculations [we find that] they do not use even half the dose, and many times they want their birds to be healthy in two or three days. So they continually change antibiotics. They are on sulfa and they change to quinolones and that's how they change, until there are three or four antibiotics for the same disease, and logically it is because they do not dose well and do not leave enough time for the birds to be cured.

Government policy

Participants in the veterinarian FGDs confirmed the indiscriminate use of antimicrobials among commercially oriented medium- and large-scale food animal producers for disease prevention and control and to promote growth. They attributed this growing problem to lack of information by producers and even veterinarians as well as incomplete government control. As one veterinarian explained, the consequences have already been noted, but alternatives are not yet readily apparent.

I believe that there should definitely be more control, but many technicians and producers lack awareness of the impact of [antibiotic resistance]. Perhaps one of the disadvantages of indiscriminate or irresponsible use of antibiotics is that we run out of tools or strategies that could work in other conditions using an antibiotic responsibly, because I think that eliminating the use of an antibiotic by itself does not make sense because then how can we treat a disease that absolutely needs an antibiotic?

Another veterinarian commented that government agencies are actually part of the problem:

No, I think that it is necessary to point out that the indiscriminate use of antibiotics that has been taking place and is being regulated. It is generated from the state agency that now gives away kits of antibiotics and medications, where antibiotics, antiparasitics, hormones ... are gifts to the producer without absolutely any control and without any explanation of how or when they should be used.

The key informant from the Ministry of Agriculture and Livestock had a contrasting viewpoint, reporting on a government plan to address the problem of antibiotic resistance by regulating sales and monitoring, while admitting that the latter is a piecemeal effort because of limited resources. She also confirmed that the sale of Colistin, an antibiotic that had been widely used for growth, had been banned since the beginning of 2020. Finally, she believes that there is increasing recognition in government circles that antimicrobial resistance is an important problem in Ecuador and must be systematically addressed:

As for whether we are aware of the importance of antimicrobial resistance at the national level, that is why as a country we are obliged and had promised that in 2017 we were going to implement a national plan to mitigate antimicrobial resistance. However, this plan, being national, had to link several ministries, the Ministry of Health, the Ministry of Agriculture, [the Secretariat of Science and Technology], the Ministry of the Environment, and other entities. The signing was delayed but in August of (2019), we had a national plan that involves (those) ministries.

Discussion

Small-scale food animal producers in the Ecuadorian highlands implement complex household survival strategies based on both economic calculations and sociocultural underpinnings that shape perceptions, attitudes, and practices. In other words, they are not a residual category of rural inhabitants that is on the way to extinction [34]. Small-scale food animal production is a heterogeneous sector in Ecuador; a portion of which, located in particular in Ecuador's coastal region, implements commercially oriented strategies including the use of veterinary products that have been linked to antimicrobial resistance [35]. In the highland region, studies conducted in the study area have found that 20 percent of small-scale

food animal producers use antimicrobials [27, 28]. This paper analyzes the reasons for which the other 80 percent do not and finds that the explanation lies in the strategies developed and implemented by backyard producers.

Focus group participants who engage in backyard food animal production describe two reasons for not using veterinary antimicrobials. First, their calculation of relative costs and benefits differ from those of commercially oriented operations that focus on profit and productivity, which is optimized by using purchased inputs including antimicrobials for disease control and prevention and for growth promotion. In contrast, their limited household incomes do not allow them to cover all their basic needs, so they engage in backyard food animal production as an important contributor to food security. As discussed in this paper, these rural households, who live in the shadow of Ecuador's capital city, avail themselves of this alternative while participating in urban labor and commercial markets, as they have for decades [26]. Veterinarians have only a general notion of non-commercial backyard food animal production because it rarely (if ever) involves their services or the use of antimicrobials for animal health or growth.

Second, these small-scale food animal producers retain a traditional reverence for interwoven threads of environmental and human health found throughout the Andean region. Centered on *Pachamama* or Mother Earth, Andean cosmivision is based on notions of balance interconnectedness, health, and diet [30, 31] and has been enshrined as rights of nature in the Ecuadorian constitution [36] and in legal frameworks elsewhere in the region [37]. Similarly, unlike their conventional counterparts, organic food animal producers in the United States eschew the use of antimicrobials as a matter of conscience as well as practicality [38].

The findings presented in this paper are based on research that faced several limitations. As in all qualitative research, focus group participants and key informant interviewees were not randomly selected, so they did not conform a representative sample of small-scale or backyard food animal producers. Rather, the study was based on theoretical sampling and systematic data analysis [33, 48] that allow for the identification of key dimensions of backyard food animal production. The findings nevertheless provide an alternative view of this phenomenon and invite further qualitative and quantitative research that could provide greater understanding of the perceptions, attitudes, and practices of this large but poorly understood group of rural inhabitants.

Conclusions

Antimicrobial resistance represents a growing threat to human and environmental health in Ecuador as it does throughout the world. The close proximity of food animals to workers and surrounding communities means that the spread of antimicrobial resistant bacteria and potential associated threats do not require direct contact; children are particularly vulnerable to bacterial infection [39]. The threat is likely to grow as large-scale industrial food animal production proliferates in Ecuador and throughout world. The threat has not gone unnoticed, however; calls to action have drawn attention to the problem a variety of alternatives have been provided [40–44].

But while antimicrobial resistance has also been associated with small-scale food animal production, alternative paths have emerged in recent years. This paper suggests that as they do in many parts of the world, limited resource backyard producers in Ecuador use a variety of traditional non-chemical remedies that are readily at hand in the household for the reasons discussed above [45]. This finding suggests that the agendas of research, technical assistance, and decision-making should consider these alternatives to antimicrobial use and misuse. In this regard, the results presented in this paper suggest that it is essential to understand the heterogeneity of the small-scale food animal production sector and that in particular, backyard producers operate with a logic that lies beyond profit and productivity and prioritize alternatives to the use of antimicrobials. Hence, researchers, veterinary technicians, and decision makers must understand the perceptions, attitudes, and practices of backyard producers with regard to the use and potential misuse of antimicrobials [46]. Moreover, limited resource rural households are reasserting the validity of their economic and cultural practices, which can be parlayed into the implementation of alternatives that promote human and environmental health [47].

Declarations

Ethics approval and consent to participate

Ethics approval was provided by the IRBs of the University of California, Berkeley and the Universidad San Francisco de Quito. All methods were carried out in accordance with relevant guidelines and regulations in the ethical approval and consent to participate. All participants provided prior informed written consent.

Consent for publication

Not applicable.

Availability of data and materials

Data and materials are available from the corresponding author upon request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

WFW, MB, JPG, ZB, and LV contributed to the conception and the design of the work. **WFW, MB, JPG, and LV** participated in field work. **WFW** and **MB** conducted the data analysis. **WFW, MB, JPG, and LV** participated in the interpretation of the data. **WFW** wrote the manuscript. **WFW, MB, JPG, ZB, and LV** reviewed and approved the final manuscript.

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